



A quantitative study of the maternal health care of different districts of Assam, India

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Abstract

Worldwide advancement with respect to health scenario has been made in recent decades in India but women and children still suffer substantial health threats, with a variety of interrelated factors. India has been experiencing noticeable disparity in terms of accessing maternal health care services at state level as well as within a state which is very prominent in most of the states of India. The focus of the study is on quantifying the coverage of maternal health care services existing in 33 different districts of Assam, a state in North Eastern Region of the country. A composite index known as MHCI (Maternal Health Care Index) is constructed through some indicators that reflect the maternal health care based on the secondary data for this purpose. The distributional structure of the composite index MHCI has been recognized to facilitate the classification of the districts based on the available maternal health services. Finally, the districts experiencing Very Poor Level of Maternal Health Care Facility are identified and probable factors responsible for such depressing condition are discussed. The findings of the study in the selected districts will be of great help for such deplorable conditions among the pregnant women so as to provide the benefits in a larger extend and with proper monitoring.

Keywords: Maternal health, Health service facilities, Maternal Health Care Index, Gamma Distribution, Assam.

Introduction

Maternal health is usually regarded as the stage of complete development of somatic, psychological, and social well-being of mother during the period of pregnancy, childbirth, and the postpartum. While the state of being a mother turns to be a positive and fulfilling experience in developed countries, but unfortunately in developing countries majority of the women undergo with suffering, ill-health and even death. One of the significant indicators of maternal health is the Maternal Mortality Ratio (MMR) employed not only to assess the status of health care that a country furnishes pregnant women but also act as a measure of existing health facilities. Throughout the world, exceptionally in the developing countries, most women in the reproductive period lack awareness about proper utilization of modern health care facilities and thereby attribute the acceleration amplitude of death. As maternal health care is considered to be an essential component for a region for its development and internal stability so a country with better basic maternal health care will attribute a low MMR. High MMR thus leads to a poor health care infrastructure.

According to the World Health Organization (WHO) out of a total of about 295000 women in the world dying during and following pregnancy and childbirth, India alone accounted for unacceptably high nearly 35000 maternal deaths in 2017¹. Every day, all over the world approximately 810 mothers lose their lives from preventable causes due to complications during child bearing ages while the lion's share of these deaths (94%)

occurred in poor-resource settings countries as reported by United Nations¹. Reduction of maternal mortality has long been a vital and persistent need in order to uplift the maternal health and one of the Millennium Development Goals (MDG) followed by international community in 2000 was to upgrade the maternal health. As per the MDG mandate, India needs to bring down its MMR by three quarters – from 437 women per 100000 live births dying due to complications in child birth in 1990 - 91, being exceptionally high, to 109 by the end of 2015². United Nations formulated the target 3.1 of Sustainable Development Goals (SDG) with an aim to lessen the global MMR below 70 per 100000 live births by 2030¹. Whatever progress has been perceived to accelerate the pace of reduction of MMR is skewed in developing countries including India across all states. WHO opines that the lives of women and newborn babies can be saved with the help of proper access of skilled care before, during and after childbirth¹. The study made by Das and Shah, 2003 highlighted the importance of proper management of health problems during pregnancy and after delivery to maintain the health of the mother³. The MMR of India has declined from 178 to 113^{4,5}. Though India has witnessed significant strides in the reduction of MMR with some targets having been met ahead of the 2015 deadline but unfortunately, India missed to achieve the MDG target and is bound to drop it to 100 by 2020⁶.

The condition of maternal deaths is even miserable in the socioeconomically deprived state of Assam which records high maternal mortality among the different states of India. The

MMR status of Assam was 215 observed almost to be the double of the national status of 113 as published by Sample Registration System 2016-18⁵. Though some improvement has taken place in absolute terms, we still have a long way to go as Assam is leading in the country with the highest MMR figure of 215. Some of the studies have documented the relationship between maternal mortality and various socioeconomic factors along with availability and functionality of health services⁷⁻⁹.

The National Family Health Survey (NFHS) in India, initiated in the early 1990s, is a nationwide large – scale, multi-round survey administered in a representative sample of households. The survey produces state and nationwide information all over India on a range of health related issues that include fertility, infant and child mortality, the practice of family planning, maternal and child health, reproductive health, nutrition, anemia, utilization and quality of health and family planning services¹⁰. The latest round of NFHS has captured the data during 2019-20. The different indicators throwing light on the maternal health care can be integrated into a single composite index. Based on the availability of data we have considered six indicators in our study to identify the extent of maternal health care exist in a district. Therefore, the present study will focus on exploring the district level scenario of maternal health care facilities based on the composite index to be developed. In a study made by Saikia and Bhattacharjee, a composite index was developed on the basis of a few indicators of health services to explore the performance of basic health facilities in different districts of Assam¹¹. In the study the researchers noticed the low development of health facilities in some of the districts that crop up mainly because of the unequal distribution of health services. Therefore the present study can lead to socio-economic, demographic and policy related factors responsible for district wise disparity of maternal health care situations.

Objectives: The present study attempts to achieve the following objectives: i. To quantify the prevailing disparities in the utilization of health care services of pregnant women in different districts of Assam with the help of indicators that reflects the maternal health care of a mother. ii. To rank 33 districts of Assam according to the values of the composite index of maternal health care to be constructed with the help of the maternal health care indicators.

Methodology

In this study the work was carried out on pregnant women to see the percentage of mother who experiences the various phases of maternal health care services. The information about relevant data collected for the study is secondary in nature. The source of district level data on the different parameters based on the maternal health care facilities are collected from the NFHS-5 on the NFHS website (<http://rchiips.org/nfhs/>) and attempted to present the latest available data¹⁰. To quantify the coverage of district wise maternal health facilities of Assam the following six maternal related indicators will be used to construct the

composite index MHCI: i. I₁: Mothers who had at least 4 antenatal care visits (%)¹⁰, ii. I₂: Mothers who had antenatal check up in the first trimester (%)¹⁰, iii. I₃: Mothers whose last birth was protected against neonatal tetanus (%)¹⁰, iv. I₄: Mothers who exhausted iron folic acid for at least 100 days during their pregnancy (%)¹⁰, v. I₅: Mothers who had registered due to which acquired Mother and Child Protection (MCP) card (%)¹⁰, vi. I₆: Mothers who experienced postnatal care served by a doctor/nurse/LHV/ANM/midwife/other health personnel accessible within 2 days of delivery (%)¹⁰.

It may be noted that the researchers have considered total number of districts of Assam to be 33 in the study due to non-availability of updated data of the newly created district Bajali (carved out of Barpeta district on 10th August, 2020) with respect to the parameters related to the maternal health care. Consequently, while constructing the composite index for the different districts of Assam, we consider (Barpeta + Bajali) together as prior Barpeta district in the present study.

Maternal Health Care Index (MHCI): Any solitary indicator fails to rate the impact of maternal health care facilities as it is a multidimensional process. The composite index, acknowledged as a convenient device in policy making, is defined as the mathematical combination of the selected six indicators that represent different dimensions of maternal health care. Here MHCI is developed to quantify the maternal health services exist in different districts. The value obtained by computing the index is believed to serve as a reflection of the existing maternal health care situation in the districts of Assam. Notation used in the maternal health care index construction depends on clarification of variables and subscript below. Let x_{ij} represents the value of the i^{th} parameter in the j^{th} district. Since there are 6 parameters and 33 districts in Assam for which data are provided by NFHS, so we have, $i = 1, 2, \dots, 6$ and $j = 1, 2, \dots, 33$. Since all the data are in percentages, so they are in the same scale of reference and thus normalizing or standardization of the data are not necessary.

The next step is to construct a composite index for comparing the districts based on all the aforesaid parameters. One must recognize the fact that all the indicators are not equally important. Thus, a simple average of the indicators should be avoided in the index construction and a weighted average shall be used. Here the entropy method is used, for determining the weights. Entropy was used in thermodynamics which was later launched by Shannon in information theory in the year 1948¹². Entropy technique is an objective way for weight determination. This method would enable to determine weights so that the indicators would best reflect the level of maternal health care amongst the different districts.

As per this method we define,

$$H_i = -k \sum_{j=1}^{33} f_{ij} \log_e f_{ij} \text{ for } i = 1, 2, \dots, 6 \quad (1)$$

Where, $f_{ij} = \frac{x_{ij}}{\sum_{j=1}^{33} x_{ij}}$ and $k = \frac{1}{\log_e 33}$

Thus the weight corresponding to the i^{th} parameter is,

$$W_i = \frac{1 - H_i}{6 - \sum_{i=1}^6 H_i} \text{ in which } 0 \leq W_i \leq 1 \text{ and } \sum_{i=1}^6 W_i = 1 \quad (2)$$

Accordingly, we reach the composite index of maternal health care as,

Maternal Health Care Index (MHCI) of the j^{th} district = $w_1x_{1j} + w_2x_{2j} + \dots + w_6x_{6j}$ (3)

Thus, corresponding to each district we shall have one value of MHCI which will serve in identifying the status of maternal health facility in a district. Each of the value shall lie between 0 to 100. Higher the value of MHCI better is the maternal health care facility in that district and vice-versa. The four mutually exclusive and exhaustive groups of districts (very poor, poor, good and very good) have been created assuming the distribution of composite index to be the Gamma distribution. The details are presented in the related section.

Distribution of the MHCI: Since the values of composite index MHCI, obtained for different districts of Assam, ranges from 0 to 100, so it follows continuous distribution. To establish the probabilistic inference, distribution of the MHCI should be investigated to enable to classify the districts in the context of the extent of maternal health care. The assumed distribution played a crucial role in obtaining the empirical outcomes¹³.

The hypothetical distribution of the MHCI can be examined with the help of chi-square test of goodness of fit or the Kolmogorov-Smirnov (K-S) test that are commonly applied in practice. But different authors have established K-S test statistics to be more appropriate for continuous data compared to the chi-square test of goodness of fit^{14,15}.

Thus, we shall apply K-S test as $MHCI_j \in [0,100]$, the values are essentially continuous in nature. The mathematical form of the statistic under the test is given by,

$$D_{\alpha,n} = \max |S_n(x) - F(x)| \quad (4)$$

Where the empirical distribution function $S_n(x)$ approaches the theoretical distribution function $F(x)$ However, in order to conduct the K-S statistic the theoretical distribution needs to be completely specified that involves the known values of the parameters. In the paper, the researchers attempted to estimate parameters on the basis of the secondary data. The significant value of D_n at the level of significance α depends on the number of observations and may be symbolized by $D_{\alpha,n}$.

Having decided the probability distribution of MHCI the focus is on obtaining three real numbers a, b and $c \in [0,100]$ to split the range of values into four mutually exclusive linear intervals viz., $[0, a]$, $[a, b]$, $[b, c]$ and $[c, 100]$ with the same probability weight of 25%, i.e.,

$$P[0 \leq MHCI_j \leq a] = 0.25 \quad (5)$$

$$P[a \leq MHCI_j \leq b] = 0.25 \quad (6)$$

$$P[b \leq MHCI_j \leq c] = 0.25 \quad (7)$$

$$P[c \leq MHCI_j \leq 100] = 0.25$$

These intervals have been used in the study to characterize the various stages of maternal health care in the j^{th} district of Assam. i. Very Poor Level of Maternal Health Care Facility if $0 \leq MHCI_j \leq a$, ii. Poor Level of Maternal Health Care Facility if $a \leq MHCI_j \leq b$, iii. Good Level of Maternal Health Care Facility if $b \leq MHCI_j \leq c$, iv. Very good Level of Maternal Health Care Facility if $c \leq MHCI_j \leq 100$.

Results and discussion

The weights W_i ($i = 1,2,\dots,8$) as presented in Table-1 can be calculated by using the formula (2) with the help of the secondary data obtained from NFHS-5¹⁰.

Having determined the weights corresponding to different parameters, the researchers focus on calculating the composite index of maternal health care for different districts. Based on district wise veritable values of the above-mentioned maternal health related parameters, weighted composite index MHCI is being obtained using the equation (3). The present study tries to explore the various dimensions of maternal health care with the help of the composite index. Based on the composite index the districts are ranked for depicting the prevailing maternal health care status of each district. The composite indices of maternal health care facilities have been displayed in the following Table-2 along with the ordinal rank of all 33 districts of Assam.

Table-1: Weights associated with different indicators used in the composite index.

Indicators	I ₁	I ₂	I ₃	I ₄	I ₅	I ₆
Weights (W_i)	0.431032812	0.204572822	0.007490211	0.237127700	0.000769627	0.119006816

Table-2: Rank of Districts based on MHCI values.

Districts	MHCI	Rank
Baksa	58.4876	23
Barpeta	52.4086	14
Biswanath	51.0853	11
Bongaigaon	46.5504	4
Cachar	40.7431	1
Charaideo	60.4205	25
Chirang	54.8586	20
Darrang	45.0794	3
Dhemaji	62.6032	27
Dhubri	44.2644	2
Dibrugarh	72.6115	32
Dima Hasao	51.5237	13
Goalpara	54.2917	19
Golaghat	68.5476	30
Hailakandi	50.3143	10
Hojai	53.2687	17
Jorhat	67.7447	29
Kamrup(R)	49.9779	9
Kamrup(M)	67.6264	28
Karbi Anglong	56.6965	21
Karimganj	47.5069	6
Kokrajhar	53.0215	16
Lakhimpur	53.6323	18
Majuli	69.6845	31
Morigaon	52.7253	15
Nagaon	59.7654	24
Nalbari	57.2635	22
Sivasagar	74.5959	33
Sonitpur	51.3449	12
South Salmara Mancachar	46.9731	5
Tinsukia	61.5869	26
Udalguri	49.2731	8
West Karbi Anglong	48.3052	7

Since the values of MHCIs are obtained to be positive (i.e., $MHCI_j > 0$), one may attach the two parameter gamma distribution as the plausible distribution. The probability density function of which is given by,

$$f(x) = \frac{1}{\lambda^\alpha \Gamma_\alpha} \left(\frac{x}{\lambda}\right)^{\alpha-1} e^{-\frac{x}{\lambda}}, \alpha > 0, \lambda > 0; 0 < x < \infty \quad (8)$$

Where $\Gamma_\alpha = \int_0^\infty e^{-x} x^{\alpha-1} dx \quad (9)$

The scale parameter λ and shape parameter α will be estimated with the help of MHCI values of all districts by using the technique of maximum likelihood estimation (MLE)¹⁶. The ML estimators are given by,

$$\hat{\lambda} = \frac{\sigma^2}{\bar{M}} \text{ and } \hat{\alpha} = \left(\frac{\bar{M}}{\sigma}\right)^2$$

Where, \bar{M} = mean of all MHCI values and σ^2 = variance of all MHCI values

Thus on the basis of the district wise calculated MHCI values of this investigation, the estimated values of the parameters are obtained as $\hat{\lambda} = 1.3$ and $\hat{\alpha} = 41.6928$. The K-S test used to examine the goodness of fit of the Gamma distribution is given by

$$D_{\alpha,n} = \max |S_n(x) - F(x)| = 0.11931$$

With corresponding p value as 0.6912, which is insignificant at 5 present level and it supports the sufficient evidence for the MHCI values to follow the two-parameter gamma distribution as defined in (8). In the study, the researchers also recourse to graphical presentation of K-S test (Figure-1) in support of the use of Gamma distribution.

The closeness of the step function (EDF) to the CDF curve, and the step function lying within the bounds, reconfirmed the model fitness to the data.

The graph reveals that the empirical distribution function (EDF) and CDF curve are very close to each other. Moreover, the step function (EDF) falls in between the upper and lower confidence bounds and hence validates the fitting of empirical data to the theoretical distribution.

Now we calculate the real numbers a, b and c under the Gamma distribution of MHCI values

From (5) $P[0 \leq MHCI_j \leq a] = 0.25$

$$\int_0^a \frac{1}{1.3^{41.6928} \Gamma(41.6928)} \left(\frac{x}{1.3}\right)^{41.6928-1} e^{-\frac{x}{1.3}} dx = 0.25$$

$\Rightarrow a = 48.3/039$ (Using Gamma function calculator)

Utilizing (6), $P[a \leq MHCI_j \leq b] = 0.25$

$$\int_a^b \frac{1}{1.3^{41.6928} \Gamma(41.6928)} \left(\frac{x}{1.3}\right)^{41.6928-1} e^{-\frac{x}{1.3}} dx = 0.25$$

$\Rightarrow b = 53.87$ (Using Gamma function calculator)

Similarly, (7) $P[b \leq MHCI_j \leq c] = 0.25$ leads to

$$\int_b^c \frac{1}{1.33^{41.6928} \Gamma(41.6928)} \left(\frac{x}{1.3}\right)^{41.6928-1} e^{-\frac{x}{1.3}} dx = 0.25$$

$\Rightarrow c = 59.7$ (Using Gamma function calculator)

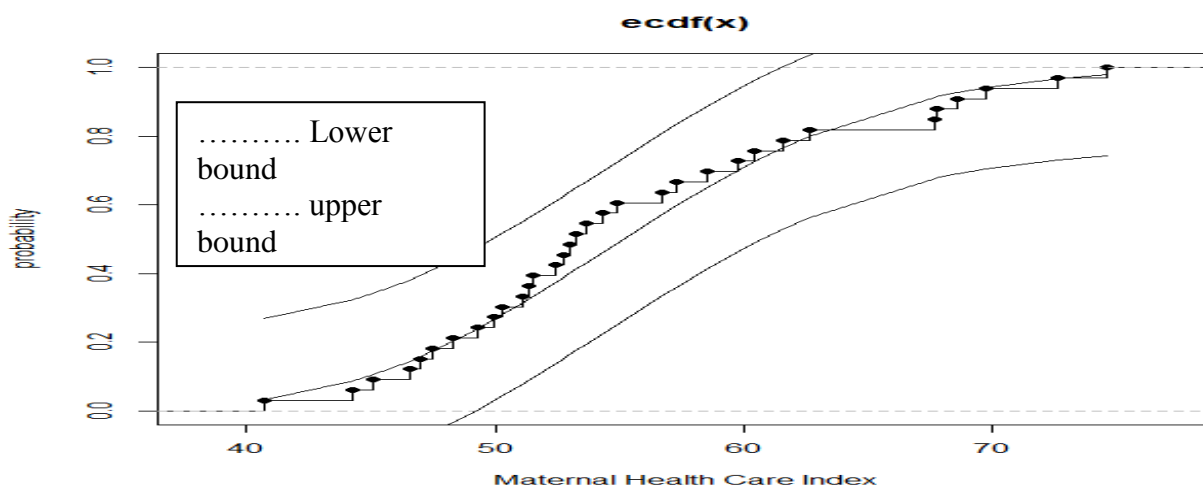


Figure-1: Graphical presentation of K – S test based on MHCI values calculated for different districts of Assam¹².

On the basis of the so obtained estimated values the various stages of MHC facilities of districts are classified as the following four levels of maternal health care in Assam:

Table-3: Categorization of maternal health facilities through MHCI.

Stages of maternal health care	Values of MHCI
Very poor level of MHC facility	Less than 48.3039
Poor level of MHC facility	Between 48.3039 to 53.87
Good level of MHC facility	Between 53.87 to 59.7
Very good level of MHC facility	Greater than 59.7

Based on categorization disclosed in Table-3, the groups of districts of Assam with regard to various stages of maternal health facilities can be displayed in the following Table-4.

Table-4: District wise categorization of maternal health care.

Stages of maternal health care	Districts of Assam
Very poor level of MHC facility	Cachar, Dhubri, Darrang, Bongaigaon, South SalmaraMancacha, Karimganj
Poor level of MHC facility	West KarbiAnglong, Udalguri, Kamrup, Hailakandi, Biswanath, Sonitpur, Dima Hasao, Barpeta, Morigaon, Kokrajhar, Hojai, Lakhimpur
Good level of MHC facility	Goalpara, Chirang, KarbiAnglong, Nalbari, Baksa
Very good level of MHC facility	Nagoan, Charaideo, Tinsukia, Dhemaji, Kamrup (M), Jorhat, Golaghat, Majuli, Dibrugarh, Sivasagar

Thus, the information presented in Table-4 has pin pointed that women of reproductive age in the six districts of Assam are

witnessing very poor level of MHC facilities. The women residing in these districts lack awareness of the existing maternal health facilities to be taken during the reproductive period. It is very clear from the Table-4 that there are twelve contiguous districts that exhibit poor level MHC facilities. On the other hand there are five contiguous districts which are classified as having good level of MHC facilities. However, it is revealed from the Table that ten districts in the district are put in the stage of very good level of MHC facility and these districts are enjoying better facilities of modern maternal health services as compared to the other blocks of districts of Assam. Thus, District wise categorization of MHC deepens our awareness about the discrepancy with regard to the practice of using maternal healthcare services. Therefore, some probable reasons for very poor level of health facilities among the six districts are discussed below so that appropriate region oriented policies and schemes can be formulated to mitigate the imbalances.

Discussion: The prime concern of the study is to quantify the maternal health facilities available in different districts of Assam as revealed in NFHS-5 based on different maternal related indicators and to identify the block of districts where the mothers are vulnerable to modern health services. The frequency of ANC visits by the mother stipulates the strength of usage of maternal health care services. A brief perusal of Table-4 documents that there are six contiguous districts which are utilizing very poor level of MHC facility in the state with respect to the particular maternal health indicators. The present study illustrates that under the stage of very poor level of MHC facility, Cachar is witnessing the worst health care facilities for mothers in the state followed by Dhubri, Darrang, Bongaigaon, South Salmara Mancachar and Karimganj. Several factors may be highlighted for very poor maternal health care facilities in the cluster of six identified districts. The depressing condition might be due to heterogeneous distribution of health care services of pregnant women within the districts. However, in the current study a number of attributes relating to maternal health care were taken into consideration hence a recapitulation at the

NFHS data as presented in Appendix 1, for those districts might reveal some indications for their deplorable situations.

It is apparent from the information given in Appendix 1 that amongst currently married pregnant women in all the six selected districts, surprisingly a dismal percentage (less than 50 %) of the mothers experienced at least four antenatal care visits while Cachar (32.7%) has shown very poor picture followed by Bongaigaon (33.9%). Though the utilization of at least four visits of ANC among pregnant women is increased from 46.4% (NFHS-4) to 50.7% (NFHS-5) but the statistic is not satisfactory. Antenatal check-up acts as a tool to encourage women for institutional delivery by the health professionals. During antenatal visits in health centers, the pregnant woman is provided the medical care for signs of ill health that may occur due to underweight, anaemia or infection and also the health of the foetus is monitored by a health worker. Through the regular visits, the awareness level of pregnant women are stimulated regarding the importance of nutrition and hygiene to upgrade their health during the childbearing periods and suggested the steps to be taken when such complications experienced. The recommended tests and measurements done along with the advice advocated during ANC leads to effectiveness of antenatal check-ups in ensuring safe motherhood. In spite of the insistence put on antenatal care by implementing various government policies, approximately half of the pregnant mothers still fail to complete required norms of antenatal visits.

Among the discussed indicators of maternal health care, it is revealed from Appendix 1 that in case of percentage of mothers receiving ANC in the first trimester, Bongaigaon (65.1%) and South Salmara Mancachar (60.1%) are ahead than other four districts while the districts with lowest percentage of mothers with respect to the indicator are Dhubri (43.9%) and Cachar (52.0%) respectively. In Assam, percentage of mothers receiving ANC in the first trimester has gone up from 55.1% (NFHS-4) to 63.8% (NFHS-5). In a study conducted in Kashmir valley reported the very poor utilization of ante-natal services (9.38% during first trimester at sub center level)¹⁷. In another study made in different districts of Assam found that 56% of the pregnant mothers utilized ANC services¹⁸.

A remarkable improvement in the percentage of pregnant women whose last birth was protected against neonatal tetanus was evident during 2019–2020. Among the districts falling under very poor level of MHC facilities Dhubri (97%) occupies the first rank, followed by Karimganj (94.2%) and South Salmara Mancachar (93%), that have crossed the state performance (94.5%), whereas Cachar recorded the least (90.0%) in the light of the utilization of the maternal care indicator.

Again, according to the NFHS-5, the percentage of women who consume iron folic acid (IFA) tablets for at least 100 days during pregnancy remains persistently low. Only 35.6 percent women in Cachar were found to be taking IFA for required

number of days and lags behind all other six districts of the very poor level of MHC facility of Assam. The finding reveals that majority of the pregnant mothers had very poor knowledge and cognizance about the consumption of IFA tablets. Iron and folic acid deficiencies during pregnancy have an adverse impact on the health of the mother as well as on foetal development. The increased awareness on IFA supplementation, adequate counselling and community education among pregnant women may lead to gaining of high knowledge levels. According to the comparative study made by Raut et al., 2018 the women consumed IFA for 90 days or more varies from 75.9% in Cambodia to 38.8% in India while the anaemia prevalence varied from 53.0% in India to 45.4% in Cambodia¹⁹.

While studying the percentage of registered mothers who received Mother and Child Protection (MCP) card, shows highly encouraging sign and sounds coverage (more than 90 %) of areas in all the districts falling under the stage of Very poor level of MHC facility. In the cluster, three districts Karimganj (99.5%), South Salmara Mancachar (99.4%) and Darrang (99.0%) have reported higher percentage of mothers receiving MCP card more than the state status (98.7%). The MCP card was launched under the National Rural Health Mission (NRHM) in 2010 to promote extent and usage of health services of pregnant women and child. The MCP card serves as a magnificent tool to enhance knowledge of pregnant women on pregnancy and child care to pregnant mothers. As the initial communication point of a pregnant woman with the health system, the MCP card has the potential to create cognizance, simplify community dialogue and generate demand for uptake of vital facilities being provided²⁰. In a study conducted in Karnataka explored the poor level of awareness among the mothers who procure an MCP card²¹.

Similarly, the present study of NFHS-5 reveals that with respect to the sixth indicator I₆, Dhubri (48.4%) is the one whose performance is disappointingly poor in the identified cluster. In a study done in Assam found that Dhubri was the lowest in receiving postnatal check-up amongst rural populations²². Here we can mention about the study made by Short and Zhang, 2004, who specifically addressed the utilization of prenatal care and professionally assisted delivery, to upgrade the health and happiness of women and children²³. According to the study by Rane et al., 2019, access to quality antenatal and post-natal services with fully functional primary care facility found to be influencing the epidemiology of maternal death²⁴. Further, the study by Sing et al. has exposed the unacceptably poor access of full ANC among Indian pregnant women with a vast and constant gap between EAG and non-EAG states since 1992²⁵.

Conclusion

Mothers bear the seed of the future generation during the reproductive time span and hence it is inevitable to upgrade massive perception on maternal health to inspire mothers to avail more health care services to lower health obstacles²⁶. This

study is devoted to identify the districts where mothers are the worst sufferers in case of utilisation of MHC facilities. It's difficult to pinpoint one particular reason for such pathetic situation. The sparse utilization of healthcare among pregnant women may be attributed to poor economic condition, ignorance and lack of knowledge about the need and benefits of healthcare utilization, regional disparities and religion wise inequality etc.. The proper allocation of health services thus needs to be reinforced, particularly among the deprived category of pregnant women. Comprehensive healthcare consciousness programs along with promoting female literacy are relevant to strengthen the healthcare services, but for the illiterate people there must be schemes to attract them health care institutes.

Regional disparities in distribution of available facilities may also be responsible for alarmingly low maternal health care in the six identified districts as majority of the population of Assam reside in rural area. The women belonging to the urban community generally enjoys the major share of the available resources which reflects the heterogeneous distribution of health services in the rural areas. Religion-wise inequalities may also be highlighted as one of the reasons that limit the usage of health care among pregnant women since majority of the districts in the identified cluster are Muslim populated where Muslim women are least conscious about the various maternal health care services to reduce their complications during child bearing ages. A study in the Indian context found that Muslim women residing in to Southern States were experiencing more maternal healthcare services compared to Northern states²⁷. The researchers perceived that Assam, Bihar, Jharkhand, Uttar Pradesh and West Bengal being the states of India with higher Muslim populations were far away from achieving the 100 percent Utilization of Skilled Birth Attendants (USBAs) in 2015 and opined that Muslim women from Northeast States were using very low maternal health services.

The government has adopted different strategies through various incentive-based schemes to encourage the pregnant mothers to avail government healthcare facilities, but the message is yet to reach the illiterate people. Some of these schemes prevalent in Assam under the umbrella of NRHM to develop the status of maternal health care landscape are Janani Suraksha Yojana

(through which a mother from rural areas receives a cash assistance of Rs. 1400 and a mother from urban area gets Rs. 1000/- for every institutional delivery up to two children), Janani Shishu Suraksha Karyakaram (Free treatment during delivery, zero transport cost from home to institute and vice versa), Mamoni (an encouragement to Ante-Natal Care which provides cash incentive for dietary supplements by releasing two cheques of Rs. 500 each on giving two TT injection taken by the pregnant mother during her pregnancy term) and Mamata (an encouragement to post-delivery hospital stays of 48 hours for post-natal care through gift incentive for the new born) etc.. Several studies were carried out to ascertain the awareness level about various sensational maternal and child health care related schemes implemented by NHM. According to the study by Dutta and Barman overall awareness level of various prospects of maternal and child health care schemes need to be increased while caste, order of birth of the children and plight of road communication of mothers play important roles towards increasing the awareness level²⁸. The study found a sound awareness level about the scheme Mamoni among the various attractive schemes of NHM. In this direction, the main thrust should be the active participation of both government and the people in general with the help of which better awareness level can be build up in the suffering areas. Another study based on rural India suggested for implementing various programmes of NRHM for the marginalized mothers falling under lower socioeconomic groups in order to reduce maternal health services disparity, especially in terms of consumption of full ANC²⁹. Once the pregnant women along with her family perceive and realize the benefits of ante-natal check-ups, intranatal and postnatal care, they will visit the health centres spontaneously for their safe health rather than been lured by cash-incentives. If this level of awareness can be generated, much of the financial burden of the government can be released. It is now necessary that the disadvantaged districts, holding very poor MHC facilities, should be given more attention incorporating adequate strategy, active manpower, proper monitoring, technical support, involving different stakeholders and collaboration from every section of people living in the society with their strong mental and moral support while formulating any development policies to alleviate the imbalances.

Appendix 1: Percentage distribution of the utilization of various maternal health indicators of women participating in the composite index belonging to the stage of Very poor level of MHC facility collected from the NFHS-5¹⁰.

District	I ₁	I ₂	I ₃	I ₄	I ₅	I ₆
Assam	50.7	63.8	94.5	47.5	98.7	65.3
Bongaigaon	33.9	65.1	91.8	46.7	98.5	57.0
Cachar	32.7	52.0	90.0	35.6	98.2	57.3
Darrang	37.5	56.5	91.1	43.3	99.0	53.2
Dhubri	37.6	43.9	97.0	47.6	98.2	48.4
Karimganj	42.2	54.8	94.2	39.9	99.5	63.9
South Salmara Mancachar	35.5	60.1	93.0	47.4	99.4	62.6

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